Selection of Candidate Eutrophication Models for Total Maximum Daily Loads Analyses in Support of the Clean Water Act

PRINCIPAL INVESTIGATORS:
John C. Imhoff
Aqua Terra Consultants
735 Main Street
Ouray, CO 81427
jcimhoff@atc.com

Robert F. Carousel
U.S. Environmental Protection Agency
Office of Research and Development
National Exposure Research Laboratory
Ecosystems Research Division
Athens, GA 30605
carousel.robert@epa.gov
228-688-1663

PROJECT DESCRIPTION

The Clean Water Act §303(d) requires the development of Total Maximum Daily Loads (TMDLs). The provisions provided in this act require each State to produce and provide the U.S. Environmental Protection Agency with a list of waters where water quality standards are not being attained, to prioritize the development of TMDLs for the waterbodies that will result in attainment of standards, and to develop and implement the TMDLs. A TMDL is an estimate of the maximum pollutant loading from point and nonpoint sources that receiving waters can accept without exceeding water quality standards. A primary environmental focus for TMDLs is the use of models for characterization of sources of nutrients and sediments and their relative loadings from the river basins, and the role of nutrients/sediments from sub-basins on water quality in rivers, lakes, and estuaries for impacts such things as excessive algal blooms, low dissolved oxygen, and related fish kills. Nutrient TMDLs that warrant a detailed characterization and assessment of receiving water bodies in many instances require the use of a eutrophication model. A methodology is presented by which seven water quality models were identified as candidates for use in developing TMDLs for nutrients and sediment.

PROGRESS TO DATE: A case study was conducted to identify/evaluate receiving water quality models that provide a means to evaluate nutrient (i.e, nitrogen, phosphorus, carbon) cycling by considering water-quality based variables and processes for Total Maximum Daily Load assessments. A large (80) number of water quality models were evaluated by searching and documenting the sources of information for science, criteria for model documentation, usage and technical support, software architecture, and nutrient (i.e, nitrogen, phosphorus, or carbon) cycling. Based on a screening process developed in previous work, seven models satisfied the minimum requirements imposed by the pre-screening. This research presents the results of the first of two detailed model evaluations in the form of comparison matrices and explanatory text of the seven water quality

models selected for use in TMDL assessments and potential linkage to watershed overland flow and transport models. Comparisons are made to hydrodynamic, sediment, water quality constituent capabilities, auxiliary model application tools and comparisons of usage, application and support. Model comparisons for each element used a two-tiered approach. First, *all* models have been compared head-to-head using general criteria. Afterwards more subtle differences between *similar* models (e.g., 3-D models) have been identified and documented using more specific criteria.

FUTURE PLANS: Detailed model evaluation of eutrophication capabilities by comparing their differences from four systems including plants (phytoplankton, periphyton, and macrophytes), the nitrogen cycle, the phosphorus cycle, the carbon cycle and dissolved oxygen balance.

PRODUCTS: A comprehensive suite of models that can be used by Federal, State, and local agencies and tribes for the determination of TMDLs.